

## PATENT SPECIFICATION



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497,641

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## COMPLETE SPECIFICATION

## Improvements in and relating to Devices for Determining Telephone Charges from Manually Set Data

We, CARL LEHNER, META GADESMANN, KARL LEICHTHAMMER and HERMANN LEICHTHAMMER, all German citizens, sole personally responsible partners of and trading in partnership as TELEFONLAU UND NORMALZEIT LEHNER & Co., of 134/140, Mainzerlandstrasse, Frankfurt a. Main, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to devices for preparing accounts for telephone subscribers.

In selector operated exchanges, the charge to be made for a connection can be determined from the setting of a meter which is acted upon by current impulses corresponding to a characteristic charge figure, number or signal selected by the calling subscriber or associated with the terminal exchange and to the duration of the connection. If an account is to be rendered to a subscriber for a particular call, the meter readings or settings immediately before and after the call have to be compared and the difference evaluated.

These automatic metering devices have the disadvantage that they do not allow sufficient grading of the charges to be made for connections in accordance with distance and time. The scale of charges has indeed to be adapted to the metering devices. Consequently, the various metering units for long distance calls are usually multiples of a basic unit which, as a rule, is the metering unit for a local call; otherwise, the metering devices have to be of very complicated construction. Furthermore, an integrating meter is objectionable from the subscriber's point of view because it does not enable him to determine the cost of a particular call. This objection is a particularly valid one where an instrument is also used by parties other than the subscriber as the authorities are not in a position to give details of any particular call of a group of calls for which the meter indicates the total charge to be made.

[Price 1/-]

In order to do away with these objections, it has been proposed to use recording devices which print or perforate a slip or card for each connection just as is done by an operator at an exchange and to use the printed or perforated records later on for establishing the charge to be made. Such automatic slip printers are generally connected to the first group selector, particularly in installations having large line finders, and record on a continuous strip of paper, the calling subscriber's number, the called subscriber's number, the characteristic "figure" of the called subscriber's exchange, the date, the time of day and the duration of the connection.

These strips are subsequently cut up into lengths each relating to one call and are filed in proper chronological order under the names of the calling subscribers and are used for making out the accounts to be rendered to the subscribers at the appropriate intervals. The charges for the various calls can be made out from day to day but it is more usual to make out the charges at longer periods, say once a month or once a quarter to avoid excessive handling of the slips.

To calculate the charge to be made from the information given on a slip, one has to take into account:—the characteristic "figure" of the terminal exchange, the time of day (to determine the appropriate scale of charges) and the duration of the connection. The terminal exchange is first of all identified from its characteristic "figure"; it is then looked up so that its distance from the calling or originating exchange can be determined; the charge is then evaluated from this distance and from the duration of the connection. This procedure takes up a good deal of time and if the accounts are typewritten, the typist repeatedly has to stop typing to look things up and make calculations. The result is that the cost of preparing subscribers accounts becomes an expensive task. This has led to the proposal to prepare the accounts automatically on a perforated card system or the like.

The device in accordance with the invention enables telephone charges to be

AMENDMENT — SEE LAST PAGE

Price 4s 6d.

determined from data manually set on a keyboard and including a factor characterising the called subscribers exchange and a factor characterising the duration of the connection. It comprises an electrical device which automatically determines the zone of the connection from the first of the said factors and an electrical device which automatically determines and indicates the charge to be made from the determined zone and the second of the said factors.

If the device is to be used in connection with calls the cost of which varies, for example, according to the time of day at which the call is made, that is to say, depends upon the tariff for the time being in force, then the data manually set on the keyboard also includes a factor characterising the tariff and the charge determining and indicating device is made dependent also upon that factor.

Such a device working in conjunction with an electrically controlled typewriter will now be described by way of example with reference to the accompanying drawing. It enables the typist to type on the subscriber's account form, line by line, the data relating to his various calls, the appropriate charges being evaluated automatically by the typewriter and being printed by electro-mechanical operation of the keys of the machine. The data typed on each line of the form as follows:

1. serial number
2. date
3. time at which call is made
4. characteristic "figure" of terminal exchange
5. called subscriber's number
6. indication of appropriate tariff (day, night and so on)
7. number of units indicating duration of connection.

From this information the typewriter is to calculate and record the appropriate charge in the appropriate column on the form.

Figure 1 of the drawings show a suitable circuit arrangement for the typewriter and for the storing devices controlled by it.

Figure 2 shows suitable circuits for the devices used for the automatic evaluation of the charges.

The typewriter can have the usual four-row keyboard comprising keys such as the key K2 and have a number of additional keys, viz: a key KK which, on being depressed, prints a K and indicates that the characteristic charge figure of the terminal exchange is about to be recorded by the following actuation of keys; a key KT indicating that the day tariff is in operation; and a key KN indicating that the night tariff is in operation. (If there are more

than two different tariffs for different times of the day, further appropriate keys corresponding to the keys T and N each characterising a particular tariff are provided). Clearly, these keys could belong to the usual keyboard and serve both to actuate mechanically the associated type levers and to initiate the appropriate switching measures. The keys can actuate the associated type levers electrically or mechanically.

A series of 5 permutation bars P.B. is arranged beneath the keyboard keys, i.e. not beneath the additional keys mentioned above. On depression of a key, certain of these bars are selected in accordance with a 5-unit code and are connected to earth, thus closing circuits for the transmission of current impulses. During the normal operation of the typewriter for recording the call data, these circuits are ineffective. On the other hand, when the key KK has been actuated, they become effective during the recording of the characteristic "figure" which follows. This "figure" may have 3, 4 or more digits.

The fundamental requirements of the arrangement are as follows:

The current impulse combination selected on depression of the keys must be used to cause the characteristic figure to be stored in automatic selector devices. The contacts in the contact banks of these selector devices H, Z, E (Figure 2) which serve to select the zone appropriate to the connection are connected to "zone points" I—V, each of which is associated with a different zone. The zone point selected by the selector devices thus indicates the zone in which the called subscribers exchange lies relatively to the calling subscribers exchange.

If, as is assumed here, there are two possible scales of charges or tariffs—one for day and one for night—a time storer Z1, Z2, Z3 (Figure 2) is provided which has two groups of contact banks. Actuation of the key KN causes that of the two contact banks which corresponds to the night tariff to be made effective. Recording on the typewriter of the duration of the connection is to cause the time storer to be set exactly as it would be in time and zone metering devices under the control of a clock.

The requirements enunciated so far are those of a time-zone meter, with this difference, that the meter is set by actuation of keyboard keys instead of by impulse contacts. The arrangement is wired appropriately to this end. A connection is provided through the zone selector to a two-way switch enabling one or the other of the day and night contact banks of the time storer to be brought into and out of

action and to the spindle of the wiper arm of the time storer. When the whole of the elements have been set, the electrical connection made through the wiper arm of the time storer is characteristic of the charge to be made. An indicating device G (Figure 2) comprising an indicating wiper arm and a contact bank suitably wired through a distributor can be used to indicate this charge.

In the known time-zone meters, the indication of the charge is given by the emission of a series of current impulses. Here, however, the indicating device selects a code combination made up of 5 current impulses and corresponding to the digits (hundreds, tens, units and so on) of the charge, which combination is capable of causing the charge to be recorded electrically in a manner similar to that which is usual in current impulse actuated telewriters. In this way, the current impulses can be distributed over five circuits instead of being transmitted at particular time intervals over a single circuit. The selected type is struck by a printing magnet of a typewriting machine. At each line shift, the various switch members are set back into the normal position. The meter setting procedure will now be described in detail.

Actuation of the key KK results in energisation of the relay C which closes a holding circuit for itself and in energisation of the driving magnet St of a control switch. This control switch has a normal or zero position and five working positions I—V in which positions it actuates one of the contacts O—V (Figure 1). On depression of the key KK it moves out of the zero position into the position I so that the five permutation bars P.B. which lie beneath the typewriter keys are connected to a set of relays RH1—RH5 which serve to store up the hundreds digit of the three-digit characteristic number of the terminal exchange. If, for example, the key 2 having the signal combination + - - + - is depressed, the 1st and 4th bars P.B. will be earthed and the relays RH1 and RH4 be energised and will be held energised in a circuit which includes their working contacts, the contact u1 and the relay F1. The relay F1 is only energised after release of the actuated key and then closes a circuit for the magnet St which steps the control switch into the position II for the reception of the next signal combination. The relay F1 is first of all short circuited by the key so that the control switch cannot come into the position II until the key is released. By depression of the key corresponding to the tens digit of the characteristic number, this digit will be stored in the relays RZ1 to RZ5.

On release of this key the control switch is moved into position III and the units digit can, by a similar procedure, be stored in the relays RE1 to RE5.

The next entry made by the typist is the called subscriber's number. This is not material in the calculation of the charge and, therefore, the recording of this number is not accompanied by a shift of the control switch. When, however, the key KN or the key KT is depressed to indicate which of the scales of charges is in force, the magnet St is again energised and steps the control switch into its position IV and the number of units of time representing the effective duration of the connection is stored in the relays RG1 to RG5. These relays are held energised in a circuit which includes the contact u4 and the relay F4.

The stored combinations now have to be transmitted to a zone determining apparatus. For this purpose, a rotary switch A is provided having arms aI to aIV each wiping over a bank of 10 contacts and a pair of arms ar1 and ar2 and off-normal arcs. These arms are stepped on energisation of the stepping magnet Da. The contacts of each set of relays RH, RZ, RE and RG are arranged pyramidally so that a particular contact in one of the banks wiped over by the arms aI—aIV can be earthed when a key is depressed and a signal combination is stored. The contacts in these banks characterise the numerals 1—0. Thus, on depression of the key K2 with the control switch in position I, contacts rh1 and rh4 of the relays RH1 and RH4 will be thrown and the second contact of the first bank of the switch A will be earthed. The testing of the first bank is effected as soon as the control switch takes up its position II. In positions II—V of the control switch, the driving magnet Da of the switch A is energised and, through the impulse relay Az, causes earth impulses to be transmitted to the driving magnet Dh of the zone selector H (Figure 2) in the circuit:

+ , contacts az2 and p3, relay V, contacts u3, u2, u1 and c, magnet Dh, —. When the arm aI arrives on an earthed contact (the 2nd in the example under consideration), the relay P connected to the spindle of the arm responds and, by means of a make-before-break contact p1, closes a holding circuit for its winding which is only opened when the arm ar1 of the switch A is restored to its zero position. Also, by means of its contact p2, it closes a new stepping circuit for the driving magnet Da. When the normal position of the switch A is reached, the arm ar2 interrupts this stepping circuit. During the stepping into the normal position, the

contact *p3* (Figure 3) prevents the transmission of impulses to the driving magnet *Dh* of the zone selector. When the normal position of the switch *A* is reached, the relay *U1* is energised in a circuit passing through the arm *ar1* and the contacts *p4*, *f1* and *u1* and is held in a local circuit. The relay *U1* connects up the arm *aII* and, on release of the relay *P*, the switch *A* is again stepped and the contact *az2* (Figure 2) transmits impulses to the driving magnet *Dz* of the zone storing selector *Z*. The relay *P* limits this emission of impulses, determines the re-setting and, in the zero position of the switch *A*, energises the relay *U2*. The switch *A* is then similarly actuated again, with respect to its third contact bank. In this way, the hundreds, tens and units digits are successively transmitted to the driving magnets *Dh*, *Dz* and *De* of the zone storing selector *H*, *Z*, *E*. The relay *U3* is then energised and the switch *A* is stepped a fourth time—over its fourth contact bank—so that the appropriate number of impulses corresponding to the duration of the connection is transmitted by means of the contact *az2* to the driving magnet *Dt* of a time storer.

The driving magnets *Dh*, *Dz*, *De* for the zone storer *H*, *Z*, *E* are illustrated in Figure 2. Rotary selectors, Strowger selectors, linear selectors, in short selectors of all kinds can be used. In the example chosen here, there are a number of rotary selectors connected in series—a selector *H* for the hundreds digit, a selector *Z* for the tens digit, a selector *E* for the units digit and a "time selector" having wiper arms *t* and *T* (Figure 2) controlled by the magnet *Dt* for storing the impulses characterising the duration of the connection. By the setting of the wiper arms of the selectors *H*, *Z* and *E*, one of the "zone points" *I*—*V* connected to the contacts *n* serving to switch over to the night tariff conditions is earthed. The relay *N* can be energised by the key *KN* and be then held through the contacts *n* and *c*.

Three setting selectors *Z1*, *Z2* and *Z3* coact with the wiper *t* of the time selector. The wipers of these setting selectors can be stepped by the driving magnets *DZ1*, *DZ2*, *DZ3*. Each of these selectors has, associated with each zone point, as many wipers as there are tariffs (in the present case, two—one for the day tariff and one for the night tariff). According to the state of energisation of the relay *N*, one or the other of these wipers is connected to the zone point. The contacts of the various contact banks of these selectors are individually connected to a distributor frame *V.St.* This frame *V.St.* is connected by a cable to a further distributor

frame *T.St.* to which the contacts of the contact banks of a charge indicator *G* are connected. In the example under consideration here, the charges are worked out on a decimal system. The contact bank wiped by the wiper *g1* of the charge indicator *G* serves to indicate the hundreds digit of the charge, the contact bank wiped by the arm *g2* the tens digit, and the contact bank wiped by the arm *g3* the units digit. Thus, the contacts of the contact bank wiped by the wiper *g1* are connected by way of the two distributor frames *T.St.* and *V.St.* to the contacts of the contact banks of the selector *Z1*; the contacts of the contact bank wiped by the wiper *g2* to the contacts of the contact banks of the selector *Z2*; and the contacts of the contact bank wiped by the wiper *g3* to the contacts of the contact banks of the selector *Z3*. These connections are such that when the three selectors *Z1*, *Z2* and *Z3* are set to the contact selected by the setting of the wiper *t*, the hundreds, tens and units digits of the amount of the charge are characterised on the three contact banks of the charge indicator *G*.

If the currency in which the charge is to be made is not a decimal currency, for example, if the charge is to be made in shillings and pence, then the contact banks associated with the wipers *g2*, *g3* must be constructed accordingly and their contacts be accordingly connected the contacts of the contact banks of the time selectors.

The cable connecting the distributor frames *V.St.* and *T.St.* is preferably provided at its ends with multi-pole plugs which can be plugged into the two frames. This makes it easy to provide the appropriate wiring between the two distributors in accordance with the tariff which forms the basis of the charges to be made.

The relay *V* releases as soon as the driving magnet *Dt* of the time storer has been fully set in accordance with the number of units representing the duration of the connection. The magnet *DZ1* (Figure 2) is immediately connected to the interrupter *RU1* through the contact *v*, the working position of the switch arm *T* and the contacts *u4*, *pz1* and *c*. The wiper arms of the selector *Z1* are rotated until the testing relay *Pz* can test through the setting of the arm *t*. All the arms of the selectors *Z1* wired for indicating the hundreds digits (shown vertically above each other in Figure 2) are then in phase with the arm *t*. A contact in the bank wiped over by the wiper *g1* of the charge indicator *G* is thus earthed through the arm of the selector *Z1* connected to the selected zone point. The driving magnet *Dg* of the charge indicator *G* is switched in on response of the relay *PZ* by the con-

tacts *pz2*. The charge indicator *G* rotates its arms *g1—g8* and *gr* until its testing relay *Pg* finds, through the arm *g1*, the earthed contact. The contact *pg1*

5 connects the wipers *g4—g8* to the permutation bar magnets *W1—W5* which are connected to the various contacts of the associated contact bank so as to characterise the combination of the signal to be given. On being energised, the magnets *W1—W5*, through their armatures, actuate the permutation bars of an electrically operated typewriter (not shown) associated with them and thus select a type 10 which is printed on response of the printing magnet *Dr*. This magnet is slow-to-respond and can only respond after response of the magnets *W1—W5*. The latter magnets and the magnet *Dr* and the devices controlled by them (not shown in the drawings) are incorporated in the typewriter, the keys of which are actuated by the typist. Preferably, a single set of types is provided so as to be actuated both 20 on manual operation of the keys and through the devices controlled by the above-mentioned magnets.

On response of the relay *Pg*, a circuit was closed for the magnet *DZ1* through 30 the contact *pg2* and the contact bank wiped by the arm *Z1r* of the selector *Z1* for resetting that selector into its zero position. The relay *U4* was also energised through the contact *pg3* and the contact bank wiped by the arm *Z1h* of the selector *Z1* and holds itself energised. It is not necessary to re-set the charge indicator *G*. On closing of the contact *u4* and release of the testing relay *Pz* which is disconnected by the contact *pg4*, the driving magnet *DZ2* is switched in and the selector *Z2* is thus stepped into a position corresponding to that previously assumed by the arm *Z1* whereupon the relay *Pz* 45 responds again and switches in the driving magnet *Dg* of the charge indicator *G* so that the latter determines the tens digit by means of its arm *g2*. On the second response of the relay *Pg*, the relay *Pz* is again disconnected. The contact *pg5* switches over so as to cause the arms *Z2*, *Z2r* and *Z2h* to return into the normal position and the contact *pg6* causes the relay *U5* to be energised, thus causing the 55 arms of the selector *Z3* to be stepped. The units digit is then determined by the arm *g3* under the influence of the relay *U5* and is printed.

The calculation and recording of the 60 charge are thus completed. The operator, by actuation of the key *ZK* (Figure 1) then effects the line shift and throws out the relay *C* which returns all those parts which are still in their working positions 65 back into their normal positions.

A stepping circuit is closed by the contact arm *St.r* and the off-normal arc of the control switch including the driving magnet *St* of this switch and an interrupter *RU* (Figure 1). Further stepping circuits are closed by the contact arms *Hr*, 70 *Zr*, *Er* and *Tr* and the off-normal arcs of the zone storers *H*, *Z*, *E* and the time storer. These circuits are controlled by an interrupter *RU2*. Also, a stepping circuit is closed by the contact arm *Gr* and the off-normal arc of the charge indicator *G*. This circuit is controlled by the interrupter *RU1*. All the switches and storers and the indicator *G* are thus 80 stepped into their normal positions whereupon those stepping circuits are interrupted.

Instead of causing the charge to be 85 printed, the arrangement can be made so as to indicate it on an electric lamp panel or any other suitable optical indicating device controlled by the relays *W1—W5* or corresponding relays. The operator will in that case type the indicated charge 90 on an ordinary typewriter and, by means of a figure keyboard independent of the typewriter, bring into action the procedure described above for zone and time storing so that on actuation of the charge indicator *G*, the hundreds, tens and units 95 digits of the charge are indicated.

In the example described above, the zone determining device is only suitable for use at the exchange relatively to which the 100 zone in which the called subscriber's exchange is situated is to be determined. It can be used, for example, for all calls originating in a large city. If, however, the exchange is to deal with calls originating from neighbouring exchanges, for example suburban exchanges, it is not necessary to provide a special converting or modifying device for each of these exchanges. All that is necessary is to alter 110 the connections between the zone storer selectors *H*, *Z*, *E* and the zone points *I—V* (see Figure 2). Exchangeable plugs *Z.St* are conveniently provided for this purpose, each wired appropriately for the various 115 exchanges so that for a call from any particular exchange it is only necessary to plug in the appropriate plug.

In the form described above, the device is suitable, in conjunction with the charge 120 slip printer, for use with automatic telephone operation. It is, however, not restricted thereto. It can be used for converting the charge-slips of manual exchanges into account forms as long as the 125 terminal exchange is indicated on the slip, not by its name but by its characteristic charge number.

The characteristic "numbers" of exchanges are frequently in the form of 130

combinations of letters and may consist of both letters and figures, the dials being then provided with letters in addition to or instead of figures. The letters correspond, of course, to simple figures and the device described above can clearly be used in such cases. It is also usual in large telephone networks for a subscriber's number to include a part of the name of the exchange. In such a case, the letters giving the indication of the identity of the exchange can be used on the charge-slips typed at the exchange and be used in the determination of the charge by the device in accordance with the invention.

Typewriters of normal construction can be used. They may, with advantage, be provided with adding devices which will print the sum of a number of recorded amounts or indicate this sum on a meter. This allows a completed account to be prepared on the machine.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A device for determining telephone charges from data manually set on a keyboard and including a factor characterising the called subscriber's exchange and a factor characterising the duration of the connection, comprising an electrical device which automatically determines the zone of the connection from the first of said factors and a further electrical device which automatically determines and indicates the charge to be made from the determined zone and the second of the said factors.

2. A device according to Claim 1, in which the data set on the keyboard includes also a factor characterising the tariff and in which the further electrical device automatically determines and indicates the charge to be made from the determined zone, the factor characterising the duration of the connection and the factor characterising the tariff.

3. A device according to Claim 1 or Claim 2, in which the zone and charge determining devices are operated by code current impulse combinations.

4. A device according to any preceding Claim, in which the charge determining device is connected to a type printing device which causes the determined charge to be printed.

5. A device according to Claims 1—3, in which the keyboard is connected to a type printing device by means of which information corresponding to the factors characterising the calling subscriber's exchange and the duration of the connection is printed.

6. A device according to Claim 5, in which the charge determining device is connected to a device for controlling the types of a typewriter which are also operable by the keyboard of the typewriter.

7. A device according to Claim 6, comprising switch means enabling the types to be struck by operation of the keyboard with or without the emission of electrical signals.

8. A device according to Claim 6 or Claim 7, in which the typewriter is arranged so that on actuation of the keys, it can send out signals which are necessary for controlling the device in accordance with the zone and the duration of the connection.

9. A device according to any one of Claims 4—8, in which the types are selected for recording the determined charge by means of current impulse code combinations, for example, the five-unit code.

10. A device according to Claim 9, in which the selecting elements are controlled for the reception of current impulses without distributing the impulses at definite time intervals over separate circuits.

11. A device according to Claim 10, having a distributor frame arranged between the outgoing lines of the zone determining device and the incoming lines of the charge determining device.

12. A device according to any preceding Claim, comprising also a time storer controlled in accordance with the factor characterising the duration of the connection.

13. A device according to Claim 12, in which the time storer co-operates with a number of selectors which cause indications of different digits of the charge to be transmitted over separate circuits.

14. A device according to Claim 13, in which the selectors are connected to the charge indicator by an exchangeable connecting member appropriate to the particular tariff for the time being in force.

15. A device according to Claim 13, in which multi-digit charge figures are transmitted so that their digits are separately indicated.

16. A device according to Claim 13, in which the selectors are set in turn to the setting of the time storer and each return into the normal position before the following selector is set.

17. A device according to Claim 16, in which the charge indicator is brought into use a number of times in succession for the various digits of the charge.

18. A device according to Claim 17, in which the charge indicator has a number of separate contact banks, one for each

digit of the charge.

19. A device according to Claim 17, in which the charge indicator in being set selects a five-unit combination which is used for recording the charge.

20. A device according to Claim 18, in which the selecting magnets of a type selecting device are connected to five different contact banks of the charge indicator.

21. A device according to Claim 7, in which the said switch means serve to initiate the storing of a signal characteristic of the called subscriber's exchange.

22. A device according to any one of Claims 12—21, comprising a key or keys for preparing a circuit for the storing of a signal characteristic of the duration of the connection.

23. A device according to Claim 22, in which the key or keys record the tariff for the time being in force.

24. A device according to any preceding Claim in which current impulse combinations corresponding to the various factors are received in separate storers so that

they can be registered independently of the speed of the zone determining device.

25. A device according to any preceding Claim, in which the current impulse combinations serve to select the contacts of 10-point rotary switch through relay contacts arranged in the form of a pyramid.

26. A device according to Claims 1 to 25, in which the actuated switching devices are automatically re-set as soon as the charge is determined and indicated.

27. A device according to Claim 26, in which the re-setting of the actuated switching devices is effected on actuation of the line shift of the typewriter.

28. A charge determining and indicating device for telephone installations substantially as described with reference to the accompanying drawings.

Dated this 19th day of April, 1937.

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## ERRATUM

SPECIFICATION No. 497,641.

Page 6, line 98, for "liner" read  
"lines"

THE PATENT OFFICE,  
March 27th, 1939.

[This Drawing is a full-size reproduction of the Original.]

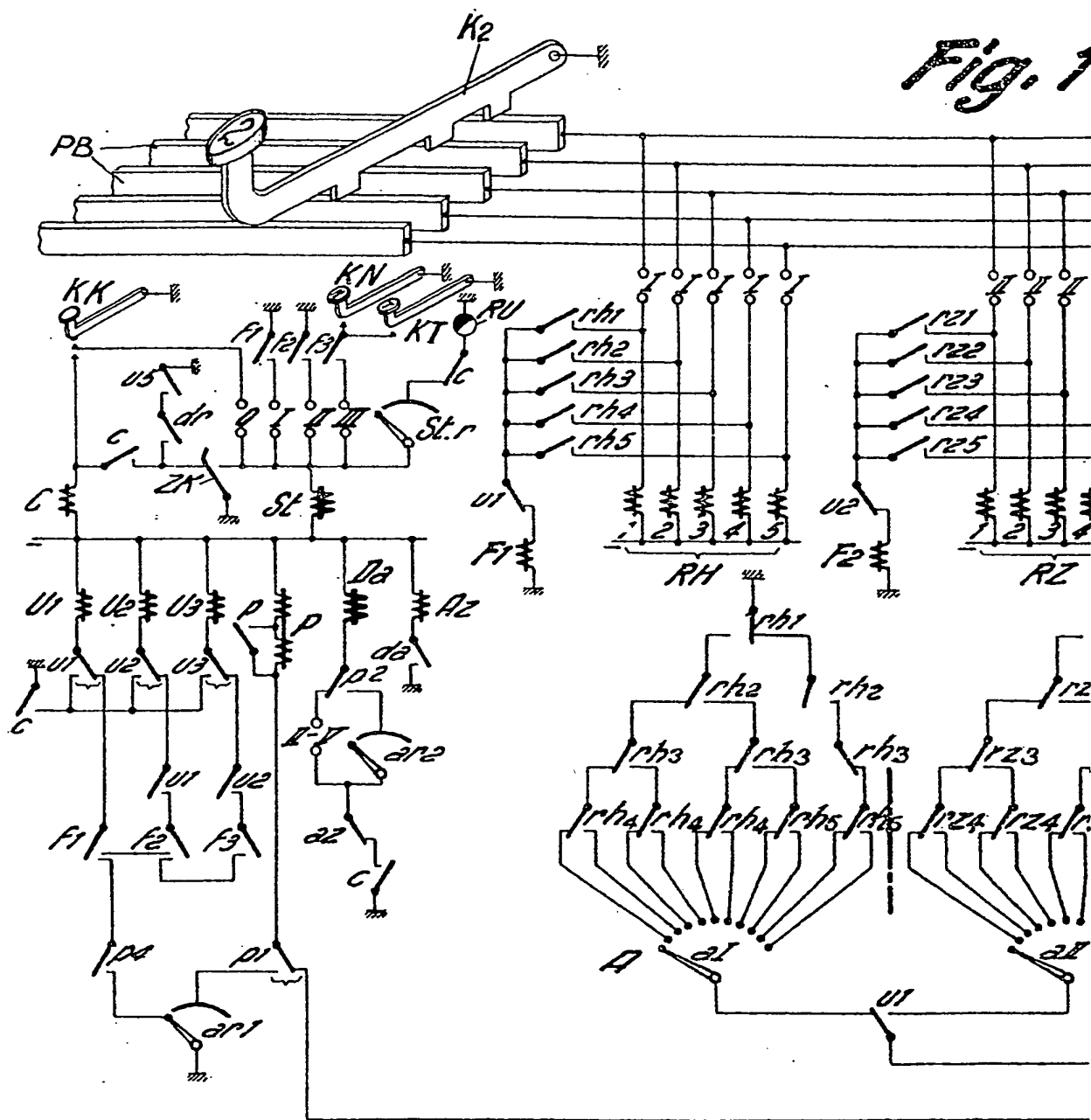




Fig. 1

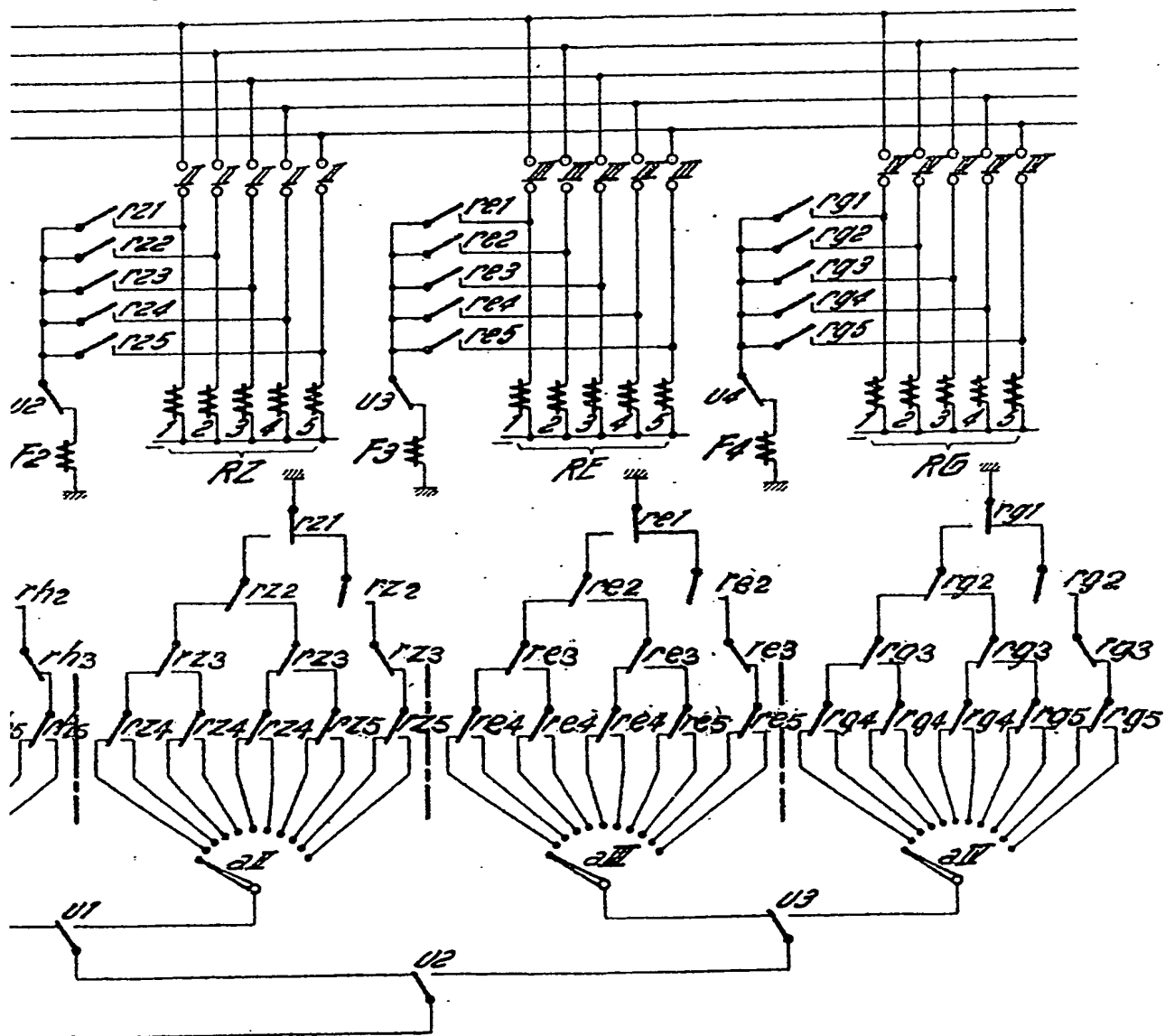
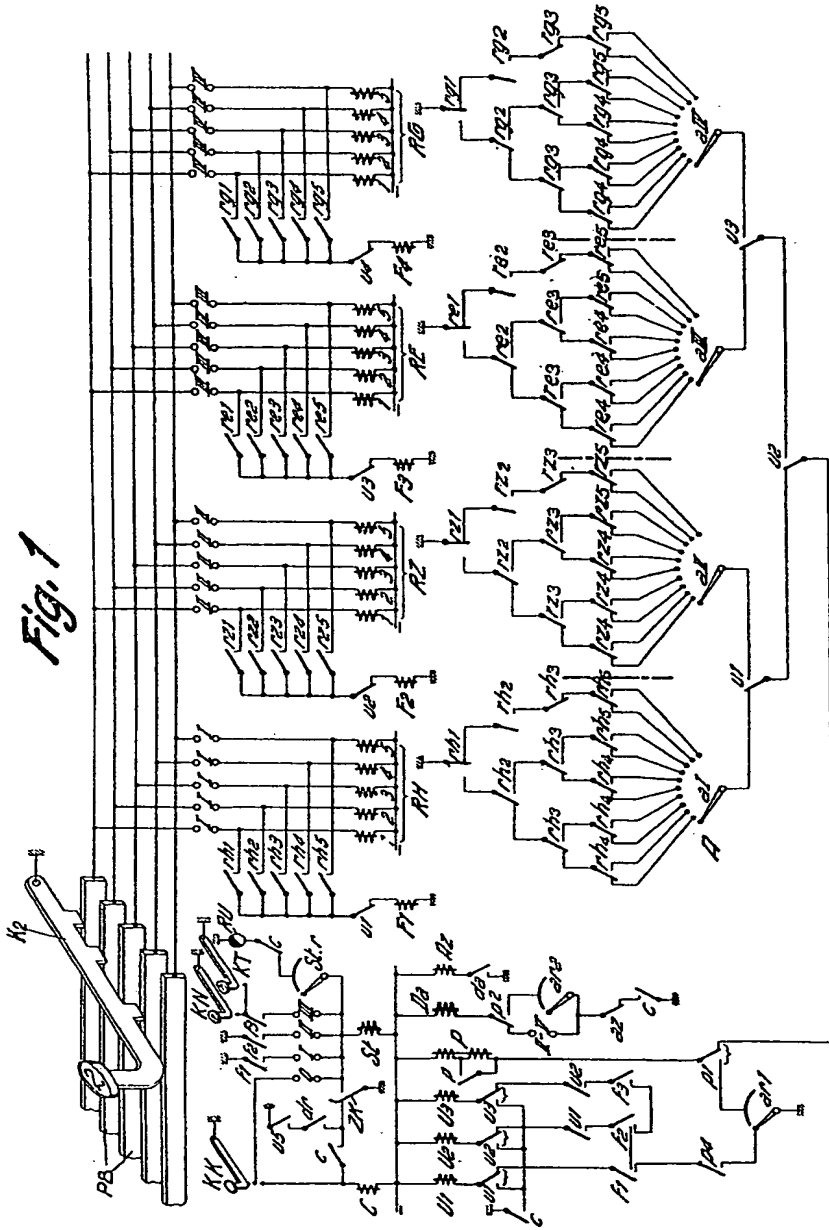
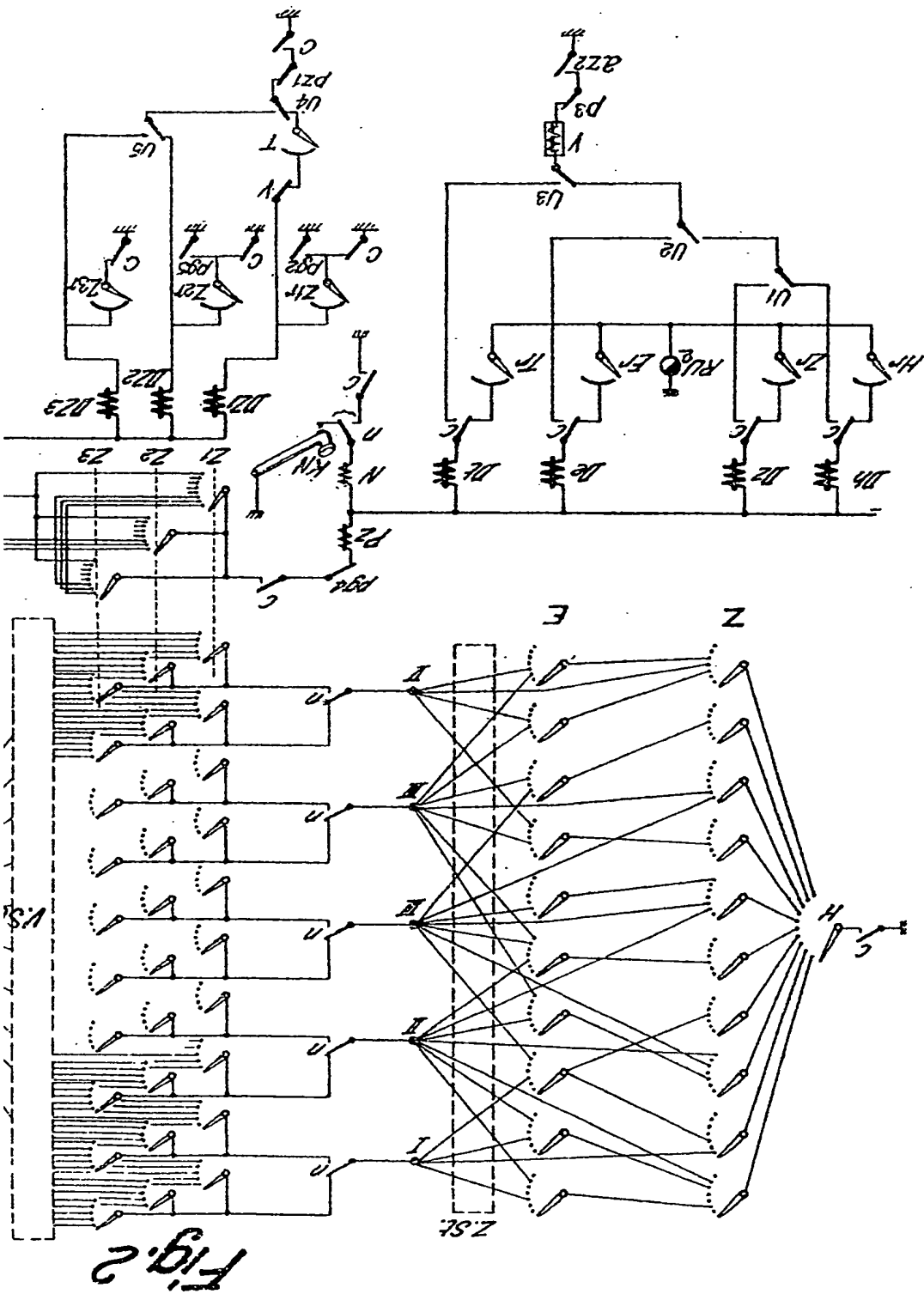


Fig. 1



[This Drawing is a full-size reproduction of the Original.]



[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 2

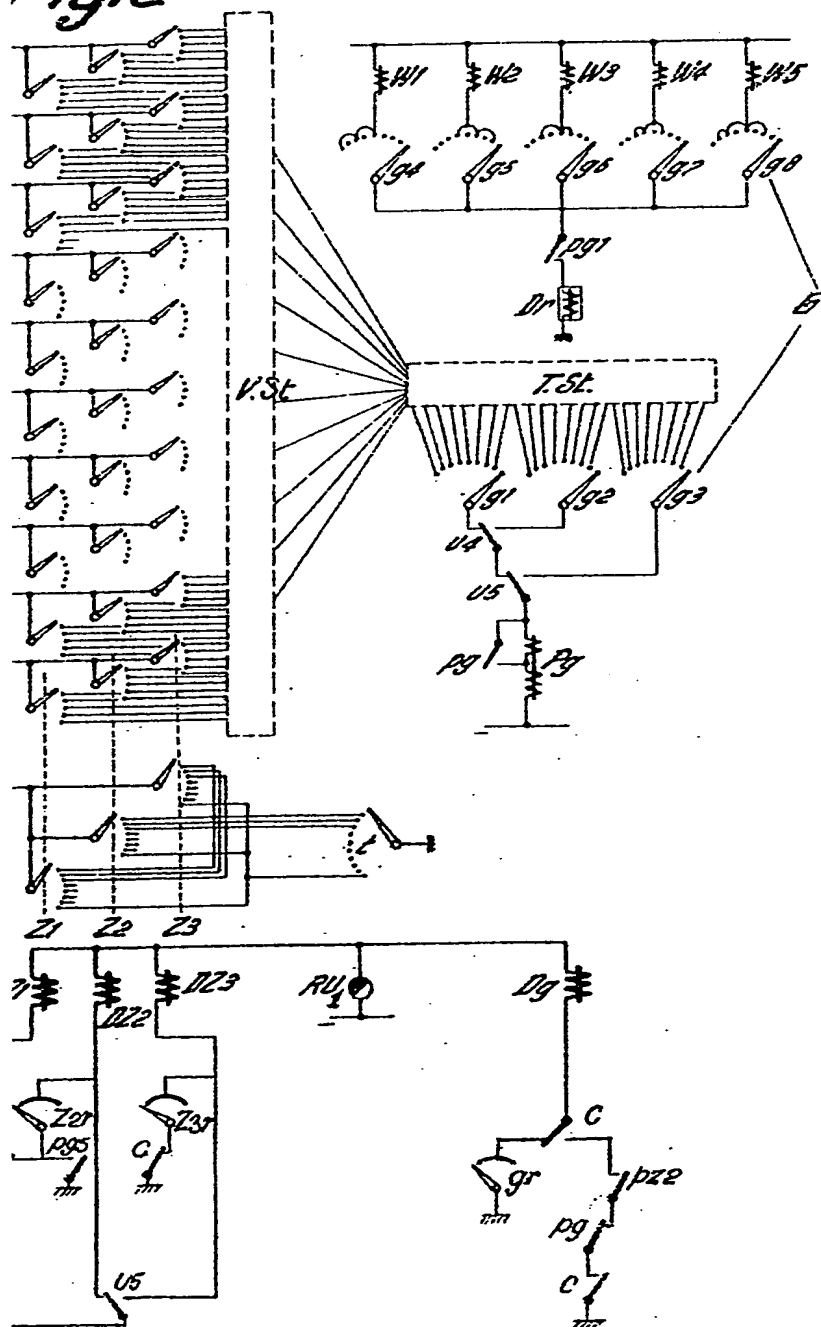
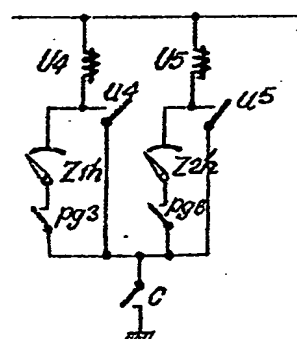


Fig. 3.



[This Drawing is a reproduction of the Original on a reduced scale.]

